Tangrams

Product code 060566

An Introduction to Manipulatives

A manipulative is any object that aids children in visualising mathematical processes. Our range of manipulatives includes Tangrams, Geoboards, Fraction Pieces, Fraction Circles, Fraction Bars, Linking Cubes, Pentominoes, Pattern Blocks and many others. However a manipulative can be as simple as a piece of string or a tin can.

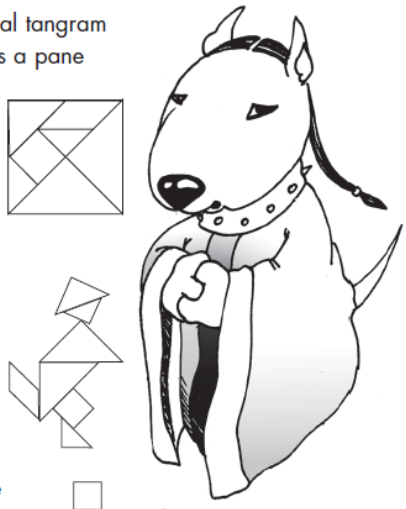
Manipulatives are invaluable in the classroom because, as modern research tells us, children retain information gained from hands-on experiences better than information they gain from memorisation. They learn in a physical way - with their hands as well as their minds. As a physical learning aid, manipulatives encourage this natural learning process by adding a concrete element to ordinarily abstract concepts.

Above all else, children enjoy working with concrete materials - in the hands of young children manipulatives will excite their natural curiosity and motivate them to take responsibility for their own learning. Children will become flexible thinkers with a knowledge of mathematics that can be applied to a wide variety of situations - instead of being taught seemingly unrelated rules, they will learn to be problem solvers.

Tangram Introduction

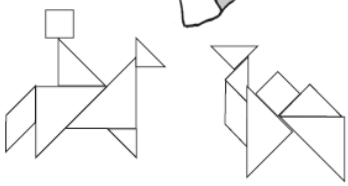
A tangram is an ancient Chinese puzzle consisting of a square cut into five triangles, a square and a parallelogram, which can be reassembled into an amazing number of different figures.

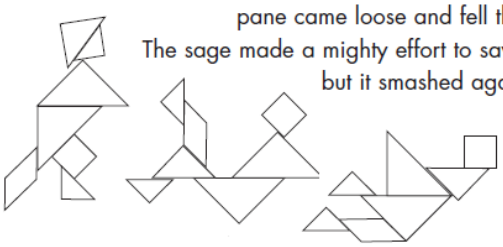
Ahead of time, create an overhead shadow or outlines of the puzzles on the right so that students can try to re-create them after you have told the story of the original tangram. For younger students draw all the shapes, for older students challenge them to find the solutions from the outline only.



Legend has it that the original tangram came for the Far East. It was a pane of glass in the shape of a perfect square. The king wanted the glass to be brought to his palace on the far side of the kingdom so he sent word that the smartest sage in all of the lands should make the journey. The sage had great respect for the king so he quickly ran to fetch the glass.

The sage put the glass pane on his back and set out on the long and treacherous journey. He travelled for a long, long time and over a long, long distance. He rode a horse across the greenest of planes. He rode a camel across the driest of deserts and sailed a ship on the roughest of seas until he came to the meanest of all mountains. He had no choice but to climb. So he stepped up to the first few rocks and began. He strived for days on end until he was so tired that his foot slipped and he tumbled down the steep slopes. The glass pane came loose and fell through the air. The sage made a mighty effort to save the pane but it smashed against the rocks. When he finally came to rest he quickly checked the glass pane. Amazingly the pane had broken into seven even pieces.





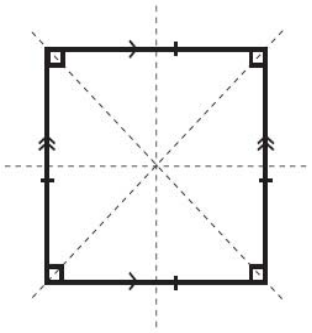
The sage struggled to put the pane back together again. By the time he had found a way to put all the pieces back into the original square he had discovered that the shapes could be rearranged into hundreds of exciting pictures. He put the pieces back onto his back and continued on his journey.

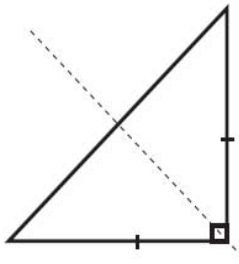
When the sage finally arrived at the palace the king was anxious to see his treasured glass pane. The sage knelt down and showed him the broken mess. The king was horrified. But then the sage showed the king all the wonderful shapes that could be made. The king was delighted, and so tangrams spread throughout the realm...

Name the Shape

A square is a regular quadrilateral. A square has:

a) four lines of symmetry
b) opposite sides parallel
c) all four angles equal to 90 degrees
d) diagonals equal and bisecting each other at right angles

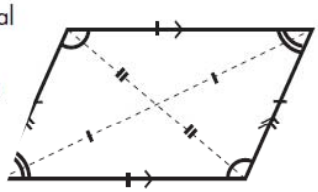




A right-angled triangle is a triangle with a right-angle as one of the three angles. A right-angled isosceles triangle also has two equal sides. Tangrams have small, medium and large right-angled, isosceles triangles. The are all similar shapes.

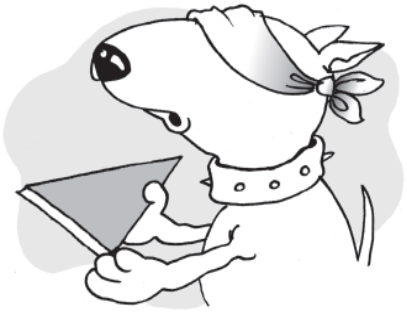
A parallelogram is a quadrilateral formed by two pairs of parallel lines. In general a parallelogram has:

a) no lines of symmetry
b) opposite sides equal
c) opposite angles of the figure equal
d) diagonals bisecting each other



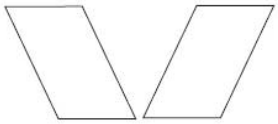
Introductory Activites

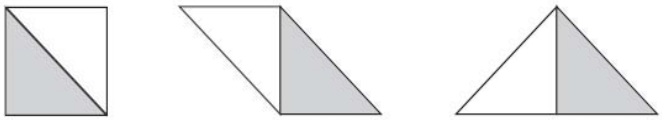
- Allow the children to engage in free play with the tangram pieces for starters. This will satisfy their natural curiosity and allow them to familiarise themselves with the shapes.



- Ask students to close their eyes, delve into the tangram container and pull out a shape. Keeping their eyes closed, ask them to determine which shape they have picked up. Can they pick up and identify more than one shape in one hand?

- Demonstrate to the children that each of the shapes can be rotated to make them fit into a particular shape except the parallelogram. This shape is the only one that may require a "flip" to make it fit correctly.

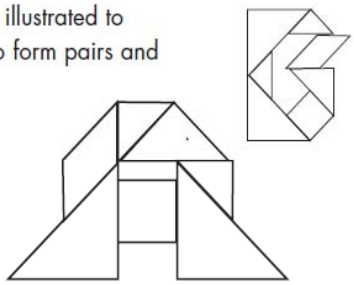




In each of the three pictures above, the grey triangle is in the same position. Ask children to find out how to move the white triangle to get from a square to a parallelogram, and from a square to a triangle. Although it is not necessary, a flip may provide a "shortcut" to a particular shape. Ask the children to describe how they did it.

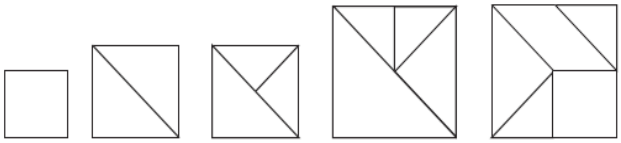
Numbers & Letters

Show the students the letter A, illustrated to right. Challenge the students to form pairs and produce the neatest B using all seven tangram pieces. Trace the results onto a poster. What about the other letters or numbers? They're all possible.



Make a Square

Make a square using 1, 2, 3, 4 and 5 tangram pieces. Some possible solutions are drawn below. What about using all 7 pieces? How many different ways can the children find to make a square using all 7 pieces? Trace the answers to keep a record.

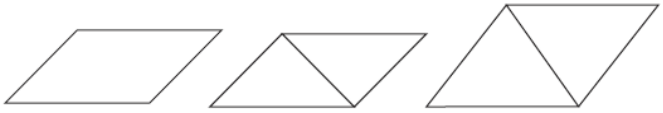


Making a square from 6 of the tangram pieces can't be done. Advanced students may notice a pattern - if the small triangle is one unit, then the area of each of the squares is a square of $2 - 2^0=1$, $2^1=2$, $2^2=4$, $2^3=8$ and $2^4=16$. 6 pieces cannot be combined to make an area that is a square of 2.

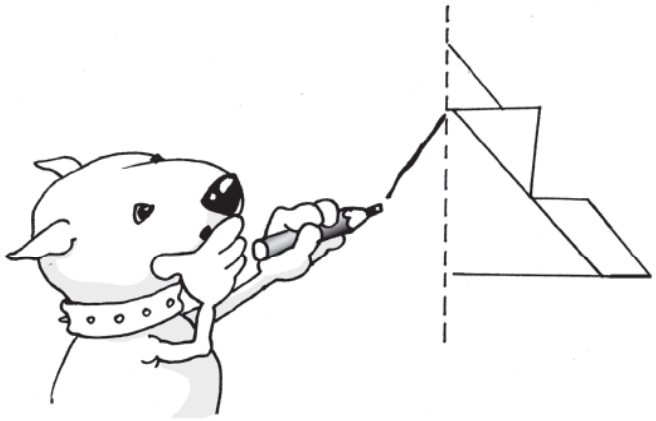
Congruent & Similar Shapes

Two objects are similar if they are the same shape but a different size. This means that all the corresponding angles are equal and all the lengths of one shape are in proportion to the corresponding lengths of the other shape. If two objects are the same shape and size they are congruent.

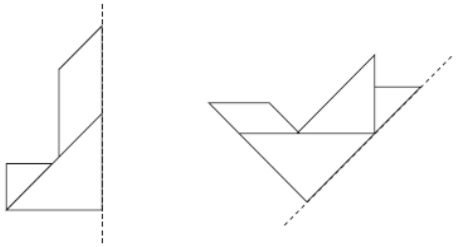
Ask students to select their parallelogram. Challenge them to use some of the other tangram pieces to make a shape that is congruent to the parallelogram. Then ask them to use other shapes to make a shape that is similar to the parallelogram. Try the same exercise with the square or medium triangle.



Axis of Symmetry

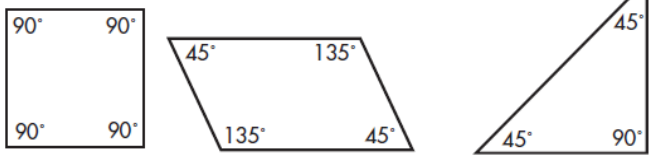


- A line of symmetry on a shape is a line which can be used as a fold, so that one half of the shape covers the other half exactly. A shape may have one or more lines of symmetry. Ask the children to investigate each of the shapes and find all of the axes of symmetry. They may want to trace the shapes onto a piece of paper and cut them out. They should find that each of the triangles has one axis of symmetry, while the square has four and the parallelogram has none. See the diagrams at the beginning of these notes for an illustration.
- Make up some pictures like the ones below and ask the children to complete the pictures so that the dotted line is an axis of symmetry. It is helpful to use a mirror for this activity.

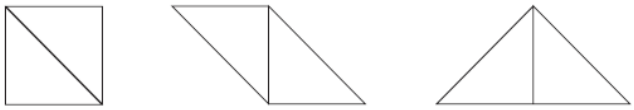


Angles

Have the students determine the angles of the various tangram shapes using the right angle of the square as a reference. Get the children to record their results. Once finished, ask them to check their answers by measuring the angles with a protractor.



Area



- Ask children to use the two small (congruent) triangles in the tangram set to form shapes congruent to three other tangram pieces: a parallelogram, a square, and a bigger triangle. Point out that these three pieces have the same area: twice the area of the small triangle.
- Ask children to arrange the pieces in order from smallest to largest and explain the criteria they used. If we use the small triangle as a "unit" we can see that the parallelogram, square and medium triangle all have an area of 2 units, while the large triangle has an area of 4 units.
- Trace around the small square and write the area as "one square unit". Ask children to determine the area of each of the other shapes with respect to the square piece.

Fractions

Ask students to create a square from all seven pieces. Ask students which part of the whole square is made up of:

- Large right triangles (1/4)
  Square (1/8)
  Small right triangles (1/16)
  Medium right triangle (1/8)
  Parallelogram (1/8)
- Change the unit value so that, for example, the large right triangle is one unit in area. Now:
  Square (1/2)
  Small right triangle (1/4)
  Parallelogram (1/2)
  Medium right triangle (1/2)

Ask students to create shapes with a particular unit value. For example, have the students make a picture having the area 5/8.